

We claim:

1. A process for separating an inlet gas stream containing methane, C2 components, C3 components and heavier hydrocarbons into a volatile gas fraction containing substantially all the methane and a less volatile hydrocarbon fraction containing a large portion of the C2+ components, the process comprising the steps of:

(a) splitting an inlet gas stream into a first feed stream and a second feed stream and cooling the first and the second feed streams;

(b) supplying a top of a packed bed cold absorber with the first feed stream and a bottom of the tower with the second feed stream where the first feed stream has a temperature colder than the second feed stream, the absorber comprising at least a first and a second packed bed and producing an absorber overhead stream, an absorber bottoms stream, and an absorber side draw stream;

(c) removing the absorber side draw stream from the packed bed cold absorber;

(d) cooling and at least partially condensing the absorber side draw stream to form a first fractionation tower feed stream;

(e) expanding and then supplying a fractionation tower with the absorber overhead stream as a second fractionation tower feed stream;

(f) supplying the fractionation tower with the absorber bottoms stream as a third fractionation tower feed stream;

(g) separating a first fractionation tower feed stream, the second fractionation tower feed stream, the third fractionation tower, and the fractionation tower reflux stream to produce a fractionation tower overhead stream that contains substantially all the methane and lighter components and a fractionation tower bottoms stream that contains substantially all the C2+ components;

(h) warming and compressing the fractionation tower overhead stream to produce a residue gas stream;

- (i) removing at least a portion of the residue gas stream as a fractionation tower reflux stream;
 - (j) cooling and supplying the fractionation tower reflux stream to the fractionation tower as a residue recycle stream; and
 - 5 (k) supplying the fractionation tower with the first fractionation tower feed stream thereby reducing an amount of the residue gas being compressed and an amount of the residue recycle gas being sent to the fractionation tower.
2. The process of claim 1, wherein the step of removing the absorber side draw stream from the packed bed cold absorber includes removing the absorber side draw stream between the first and
10 the second packed beds.
3. The process of claim 1, wherein the step of splitting the inlet gas stream includes splitting the inlet gas stream so that the first feed stream contains about 70% of the inlet gas stream and the second feed stream contains about 30% of the inlet gas stream.
4. The process of claim 1, wherein the step of cooling the first and second feed streams includes
15 the steps of:
- (a) cooling the first feed stream by heat exchange contact with a stream selected from the group consisting of the absorber side draw stream, the residue recycle stream, the fractionation tower overhead stream, and combinations thereof; and
 - (b) cooling the second feed stream by heat exchange contact with a stream selected from
20 the group consisting of a first reboiler bottoms stream, a second reboiler bottoms stream, and combinations thereof.
5. The process of claim 1, the step of cooling the absorber side draw stream so that the absorber side draw stream is substantially condensed includes cooling the absorber side draw stream so that the absorber side draw stream is essentially in liquid phase.
- 25 6. The process of claim 1, further including the step of expanding the absorber bottoms stream prior to supplying it to the fractionation tower.

7. The process of claim 1, further including the step of expanding the absorber side draw stream prior to supplying it to the fractionation tower.

8. The process of claim 1, further including the step of expanding the residue recycle stream prior to supplying it to the fractionation tower.

9. A process for separating an inlet gas stream containing methane, C2 components, C3 components and heavier hydrocarbons into a volatile gas fraction containing substantially all the methane and a less volatile hydrocarbon fraction containing a large portion of the C2+ components, the process comprising the steps of:

(a) splitting an inlet gas stream into a first feed stream and a second feed stream and cooling the first and the second feed streams;

(b) supplying a top of a packed bed cold absorber with the first feed stream and a bottom of the tower with the second feed streams where the first feed stream has a temperature colder than the second feed stream, the absorber comprising at least a first and a second packed bed and producing an absorber overhead stream, an absorber bottoms stream, and an absorber side draw stream;

(c) removing the absorber side draw stream from the packed bed cold absorber;

(d) cooling and at least partially condensing the absorber side draw stream;

(e) expanding and then supplying a fractionation tower with the absorber overhead stream as a second fractionation tower feed stream;

(f) supplying the fractionation tower with the absorber bottoms stream as a third fractionation tower feed stream;

(g) separating a first fractionation tower feed stream, the second fractionation tower feed stream, the third fractionation tower, and the fractionation tower reflux stream to produce a fractionation tower overhead stream that contains substantially all the methane and lighter components and a fractionation tower bottoms stream that contains substantially all the C2+ components;

- (h) warming and compressing the fractionation tower overhead stream to produce a residue gas stream;
- (i) removing at least a portion of the residue gas stream as a fractionation tower reflux stream;
- 5 (j) cooling and supplying the fractionation tower reflux stream to the fractionation tower as a residue recycle stream; and
- (k) adding the absorber side draw stream to the residue recycle stream to form a first fractionation tower feed stream and supplying the fractionation tower with the first fractionation tower feed stream thereby reducing an amount of the residue gas being
- 10 compressed and an amount of the residue recycle gas being sent to the fractionation tower.
10. The process of claim 9, wherein the step of removing the absorber side draw stream from the packed bed cold absorber includes removing the absorber side draw stream between the first and the second packed beds.
- 15 11. The process of claim 9, wherein the step of splitting the inlet gas stream includes splitting the inlet gas stream so that the first feed stream contains about 70% of the inlet gas stream and the second feed stream contains about 30% of the inlet gas stream.
12. The process of claim 9, wherein the step of cooling the first and second feed streams includes the steps of:
- 20 (a) cooling the first feed stream by heat exchange contact with a stream selected from the group consisting of the absorber side draw stream, the residue recycle stream, the fractionation tower overhead stream, and combinations thereof; and
- (b) cooling the second feed stream by heat exchange contact with a stream selected from the group consisting of a first reboiler bottoms stream, a second reboiler bottoms
- 25 stream, and combinations thereof.

13. The process of claim 9, the step of cooling the absorber side draw stream so that the absorber side draw stream is substantially condensed includes cooling the absorber side draw stream so that the absorber side draw stream is essentially in liquid phase.

14. The process of claim 9, further including the step of expanding the absorber bottoms stream prior to supplying it to the fractionation tower.

15. The process of claim 9, further including the step of expanding the first fractionation tower stream prior to supplying it to the fractionation tower.

16. An apparatus for separating an inlet gas stream containing methane, C2 components, C3 components and heavier hydrocarbons into a volatile gas fraction containing substantially all the methane and a less volatile hydrocarbon fraction containing a large portion of the C2+ components, the apparatus comprising:

(a) a first cooler for cooling a first feed stream and a second feed stream;

(b) a packed bed cold absorber for receiving the first feed stream and the second feed stream where the first feed stream has a temperature colder than the second feed stream, the absorber comprising at least a first and a second packed bed and producing an absorber overhead stream, an absorber bottoms stream, and an absorber side draw stream, the absorber side draw stream being removed between the first and the second packed beds;

(c) a first expander for expanding the absorber overhead stream;

(d) a fractionation tower for separating a first fractionation tower feed stream, the absorber overhead stream as a second fractionation tower feed stream, the absorber bottoms stream as a third fractionation tower feed stream, and a fractionation tower reflux stream, the fractionation tower producing a fractionation tower overhead stream that contains substantially all the methane and lighter components and a fractionation tower bottoms stream that contains substantially all the C2+ components;

(e) a first heater for warming the fractionation tower overhead stream;

(f) a first compressor for compressing the fractionation tower overhead stream to produce a residue gas stream;

(g) a second cooler for cooling the at least a portion of the residue gas stream; and

(h) a third cooler for cooling and at least partially condensing the absorber side draw stream to form the first fractionation tower feed stream.

17. The apparatus of claim 16, further including a fourth cooler for cooling and at least partially condensing at least a portion of the inlet gas stream.

18. The apparatus of claim 16, wherein the first cooler, the second cooler, the third cooler, and the first heater comprise a single heat exchanger that provides heat exchange contact with each of these streams.

19. The apparatus of claim 16, further including a second expander for expanding at least a portion of the absorber bottoms stream prior to being sent to the fractionation tower.

20. The apparatus of claim 16, further including a third expander for expanding at least a portion of the residue recycle stream prior to being sent to the fractionation tower.

21. The apparatus of claim 16, further including a fourth expander for expanding at least a portion of the absorber side draw stream prior to being sent to the fractionation tower.